

CHAPTER 10

MECHANICAL

10-1. GENERAL. Design requirements for mechanical design are provided in this chapter. Mechanical design will comply with the Architectural and Engineering Instructions Design Criteria published by Headquarters, U.S. Army Corps of Engineers. All drawings will be prepared as described in chapter 2, Presentation of Data. Drawings will reflect all requirements contained in the contract specifications where possible. Energy conservation and life cycle cost design features will be reflected in the Energy Conservation and Life Cycle Cost Design Analysis specified in chapter 1.

10-2. PURPOSE AND APPLICABILITY. The purpose of this chapter is to ensure that designs provide a firm basis for obtaining equipment and items which are operable, maintainable, measurable, cost effective, and technically sound. The requirements contained in this chapter apply to all designers, A-E's, and contractors in developing and constructing facilities for which USAEDH has design responsibility.

10-3. REFERENCE PUBLICATIONS. The most current edition of the publications listed below constitute an addendum to this chapter. In addition, the requirements of the appropriate Corps of Engineers Guide Specifications will be incorporated into designs.

- a. TM 5-785, Engineering Weather Data
- b. TM 5-805-4, Noise and Vibration Control for Mechanical Equipment
- c. TM 5-805-10, Seismic Design For Buildings
- d. TM 5-810-1, Heating, Ventilating, and Air-Conditioning
- e. TM 5-810-2, High Temperature Water Heating Systems
- f. TM 5-810-3, Mechanical Refrigeration & Ventilation in Cold-Storage Facilities
- g. TM 5-810-4, Compressed Air
- h. TM 5-810-5, Plumbing
- i. TM 5-810-6, Nonindustrial Gas Piping Systems
- j. TM 5-810-7, High-Pressure Gas and Cryogenic Systems
- k. TM 5-814-4, Incinerators
- l. TM 5-815-1, Air Pollution Control
- m. TM 5-815-3, Heating, Ventilating, and Air-Conditioning Control Systems
- n. TM 5-838-2, Army Health Facility Design

- o. TM 5-840-2, Storage Depots
- p. TM 5-848-1, Gas Distribution
- q. TM 5-848-2, Handling of Aircraft and Automotive Fuels
- r. TM 5-855-4, Heating, Ventilating, and Air Conditioning of Hardened Facilities
- s. TM 5-882-3, Heating, Ventilating, and Air Conditioning - Emergency Construction
- t. Military Handbook 1008B, Fire Protection For Facilities Engineering, Design, and Construction
- u. AMCR 385-100, Safety Manual

10-4. FIRE PROTECTION. Unless the project scope of work specifies the performance design of the fire protection system, the designer will show all information necessary to construct the fire protection system(s) ("total design"). The information provided will be detailed to the extent that the construction contractor will only provide shop drawings that show compliance with the contract requirements. Where the project SOW specifies the "performance design" of a water sprinkler system, the designer will include the following in the contract documents: water system supply curve plotted on semi-logarithmic paper, occupancy classification, design density, design area, hose stream (where applicable), and duration of the water supply. The performance design will include adequate hydraulic calculations to determine if the facility will require fire pumps or water storage tanks. If calculations demonstrate the need for either item, the designer will prepare in detail the design. The designer will ensure that all designs provide the most cost effective fire protection that complies with all applicable requirements and does not increase the risk of property damage or adversely impact life safety considerations.

a. Concept Design

(1) Design Analysis General Description. A description of the system(s) to be used along with a list of standards (including date and reference to applicable sections or paragraphs) upon which the design is based will be submitted. A preliminary version of the Fire Protection Design Analysis specified in chapter 1 will also be included in the general description.

(2) Design Analysis Calculations. For "total" or "performance design" of water sprinkler systems, the hydraulic calculations specified above for "performance" designs will be submitted at this stage. An equivalent level of information will be submitted at this stage for other extinguishing systems. The calculations required for a "performance design" should be essentially complete at this point. The source for each equation used will be listed, including title, chapter, equation number, etc.

(3) Drawings. For either "performance" or "total" design concept drawings, the information specified above for "performance design" of a water sprinkler system, or the equivalent information for other extinguishing systems will be submitted. Equipment will be drawn to scale.

b. Final Design

(1) Design Analysis General Description. The concept description will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented. The final version of the Fire Protection Design Analysis specified in chapter 1 will also be included in the general description.

(2) Design Analysis Calculations. The concept calculations will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented. Catalog cuts from at least three vendors, sufficient in detail to demonstrate compliance with all contract requirements including the contract specifications, will be included for all major items of equipment. For "total design" of water sprinkler systems, completed hydraulic calculations or the equivalent information for other extinguishing systems will be submitted. The calculations will substantiate that the design area indicated is, in fact, the most hydraulically demanding. Computer prepared hydraulic calculations will have a cover sheet that includes design input and provides an explanation of output generated. Output will include a plot of the water system supply and the sprinkler system demand curves plotted on semi-logarithmic paper. Computer software which uses typical k-factors for branch lines will not be used. All calculations will be accompanied by sketches that identify areas, nodes, piping segments, etc., used in the calculations to facilitate review.

(3) Drawings. The performance requirements of all equipment will be included in an appropriate schedule. A sequence of operation will be included where required to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, all valves, gauges, and fittings required by the specifications or otherwise required will be shown. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details of mechanical rooms and all other congested areas will be provided where required for clarity and coordination. All piping within the mechanical room and all other congested areas will be drawn double-line (to scale). All supports, other than standard piping supports, will be shown on the drawings and clearly detailed. Flow diagrams and/or isometrics and sequences of operation will also be provided as needed for clarity. Fire protection drawings will not contain information pertaining to other disciplines, except where required for reference or coordination.

(a) For "performance design," the concept drawings will be updated to reflect any changes made to the design since the concept submittal.

(b) For "total design," the concept drawings will be expanded to include the location of all sprinklers, risers, and piping, or the equivalent information for other extinguishing systems. Center-to-center dimensions between sprinklers on branch lines and between branch lines, from end sprinklers to adjacent walls, from walls to branch lines, from sprinkler feed mains and cross mains and branch lines to finished floors and roof or ceiling will be shown. Sections will be included that show typical branch line and cross main pipe routing as well as the elevation above finished floor for typical sprinklers.

10-5. PLUMBING

a. Concept Design

(1) Design Analysis General Description. A description of the system(s) to be used along with a list of standards (including date and reference to applicable sections or paragraphs) upon which the design is based will be submitted.

(2) Design Analysis Calculations. Systems and equipment selection will be based on life cycle cost consideration. The life cycle cost analysis and the energy budget calculations will either be included here or reference will be made to the section that contains the analysis. The number and type of all plumbing fixtures required will be provided along with calculations to determine the cold and hot water load (flow) requirements. The types and capacity requirements for drainage systems will also be included. Calculations necessary to determine equipment capacities and their corresponding utility requirements will be provided. To facilitate review, all calculations will be accompanied by sketches that identify nodes, piping segments, etc., used in the calculations. The source of each equation used will be listed, including title, chapter, equation number, etc.

(3) Drawings. The drawings will include plumbing fixture layout, floor and area drains, and single-line piping and equipment layout. All equipment will be drawn to scale. Preliminary performance requirements of all equipment will be included in appropriate schedules.

b. Final Design

(1) Design Analysis General Description. The concept description will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented.

(2) Design Analysis Calculations. The concept calculations will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented. All pipe sizing calculations will be completed at this stage. For all pipes, the calculations will include design flow (in gpm and the appropriate fixture units), pipe size, velocity, friction factors, slopes, lengths, and the pressure and flow available at each fixture at designed conditions. Catalog cuts sufficient in detail to demonstrate compliance with all contract requirements, including the contract specifications from at least three vendors, will be included for all major items of equipment.

(3) Drawings. A plumbing fixture schedule will be provided that lists individual fixtures and the size of all piping connections (cold water, hot water, and waste). The performance requirements of all equipment will be included in an appropriate schedule. A sequence of operation will be included, where required, to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, all valves, gauges, and fittings required by the specifications or by other standards will be shown. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details of mechanical rooms and all other congested areas will be provided as necessary for clarity and coordination. All piping within the mechanical room and all other congested areas will be drawn double-line (to scale), with exterior dimensions that include any required insulation. All supports, other than standard piping supports, will be shown on the drawings and clearly detailed. Isometrics and

sequences of operation will also be provided as needed for clarity. Plumbing drawings will not contain information pertaining to other disciplines, except where required for reference or coordination.

10-6. HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

a. Concept Design

(1) Design Analysis General Description. A description of the system(s) to be used along with a list of standards (including date and reference to applicable sections or paragraphs) upon which the design is based will be submitted. The indoor and outdoor design conditions will be listed for each area.

(2) Design Analysis Calculations. System and equipment selection will be based on life cycle cost considerations. The life cycle cost analysis and the energy budget calculations will either be included here or reference will be made to the section that contains the analyses. A preliminary ventilation analysis based on the requirements listed in TM 5-810-1 will be provided. The design will meet all ventilation requirements. Conformance to ventilation requirements will also be done in a manner that is life cycle cost effective. Where energy from an existing plant is to be used, verification will be included that capacity, availability, and the reliability of the plant is adequate to serve the intended loads. As a minimum, block loads that take into account all loads that will influence equipment size will be submitted for each system. All calculations will be accompanied by sketches that identify nodes, piping, or duct-work segments, etc., used in the calculations to facilitate review. The size of major pipe and duct mains will be included. The source for each equation used will be listed, including title, chapter, equation number, etc.

(3) Drawings. A single-line layout will be provided for all equipment, ductwork, and piping. Equipment will be drawn to scale. Preliminary performance requirements of all equipment will be included in appropriate schedules. A preliminary sequence of operation for each system will be included on the drawings.

b. Final Design

(1) Design Analysis General Description. The concept description will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented.

(2) Design Analysis Calculations. The concept calculations will be updated to reflect any changes made to the design since the concept submittal. The bases for changes will be documented. All pipe sizing calculations will be completed at this stage. For all pipes, the calculations will include design flow (over the entire range where applicable), pipe size, velocity, friction factor, slope and length. Likewise, for all ducts, the calculations will include design flow (over the entire range where applicable), duct size, velocity, slope (if applicable), length and all pertinent details relative to the calculation method used. The entering and leaving design conditions at each piece of equipment (over the entire operating range where applicable) will be listed. The cycle of each heating and/or cooling system will be plotted on a psychrometric chart with each point on the chart cross-referenced to the corresponding point in the system. Individual room heat gain/loss calculations will be made. The extrapolation of "typical" room calculations or the proration of block load calculations will not be permitted. A

completed ventilation analysis based on the requirements listed in TM 5-810-1 will be provided. Catalog cuts from at least three vendors sufficient in detail to demonstrate compliance with all contract requirements, including the contract specifications, will be included for all major items of equipment.

(3) Drawings. The performance requirements of all equipment will be included in appropriate schedules. A sequence of operation will be included where required to clearly understand the function or operation of any systems or equipment. All equipment will be shown in detail. Where equipment connection details are shown, all valves, gauges, and fittings, required by the specifications or otherwise required will be shown. For proper operation and maintenance of the equipment, adequate space will be allotted based on the requirements in the catalog cuts furnished above. Clearances or access required for proper operation and maintenance will be shown on the drawings. Sections, elevations, and details will be provided for mechanical rooms and all other congested areas where required for clarity, coordination, or detail. All piping and ductwork within the mechanical room and all other congested areas will be drawn double-line (to scale) with exterior dimensions that reflect any required insulation. All supports, other than standard ductwork or piping supports, will be shown on the drawings and clearly detailed. A flow diagram and sequence of operation will be provided for each system. HVAC drawings will not contain any information pertaining to other disciplines, except where required for reference or coordination.